CAFC2 System Engineering: Domain Engineering Update

CAFC2 System Engineering Group

27 January 1999

Purpose & Outline

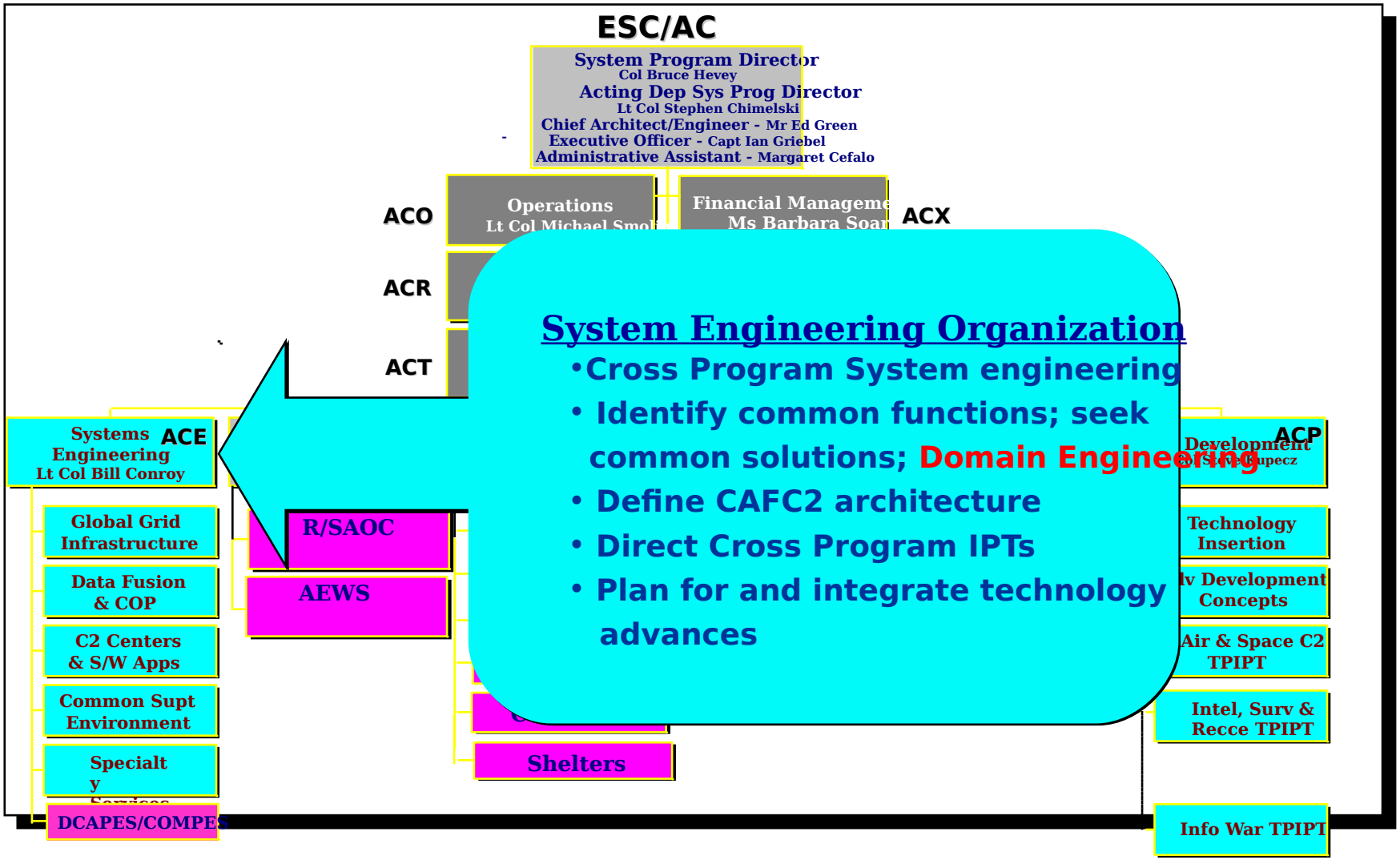
Purpose:

- To provide details of the Domain Engineering initiatives of the CAFC2 SPO System Engineering Group

Outline:

- System Engineering Overview
- CAFSPO Domain Engineering
  - Information Repository
  - Identifying Common Functionality
- The Other Puzzle Pieces
  - Technology & Architecture
- Business Strategies
- Next Steps: A Possible Roadmap

CAF C2 SPO



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Domain Engineering: The Definitions

From CAO:

Domain: An area of activity or knowledge with a set of common capabilities and data

Domain Engineering: A process for the systematic analysis of an enterprise and the resulting design of an architecture and a set of reusable assets that can be used to construct a family of related applications or subsystems

Our Definition: Analyzing CAFC2 programs and looking for opportunities for common solutions to common requirements

Need tools to help the analysts

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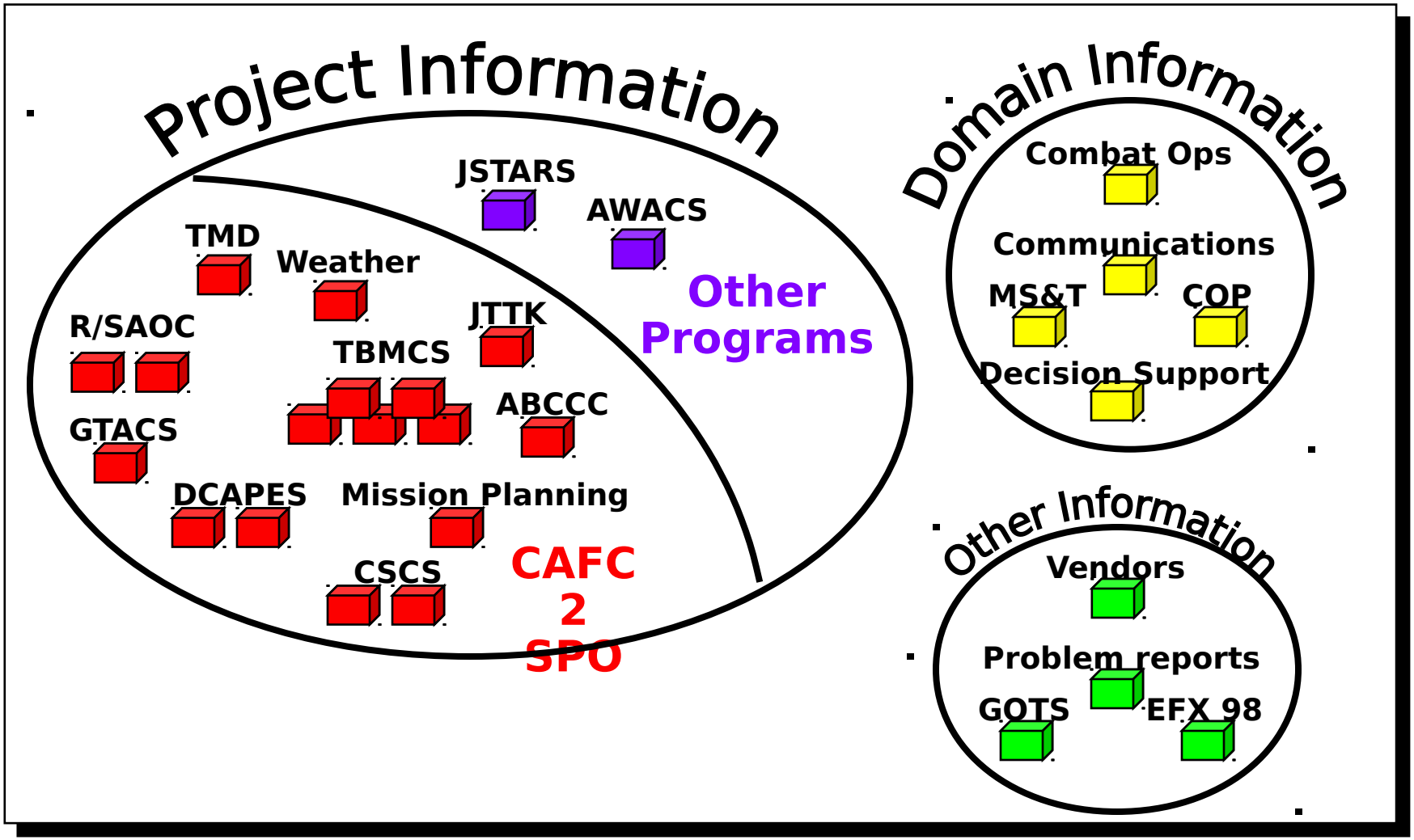
The CAFC2 SPO Domain Information Repository

- Embodies some of the same concepts as a data warehouse
  - Store broad classes of information
  - Provide methods to summarize information
- Our vision
  - Provide a searchable repository for project information
    - Functional Descriptions
    - Requirements Documentation (Current and Future)
    - Segment Catalogs
    - CSCI Descriptions
    - Anything else that might be useful

The CAFC2 SPO Domain Information Repository



The CAFC2 SPO Project Information - Status

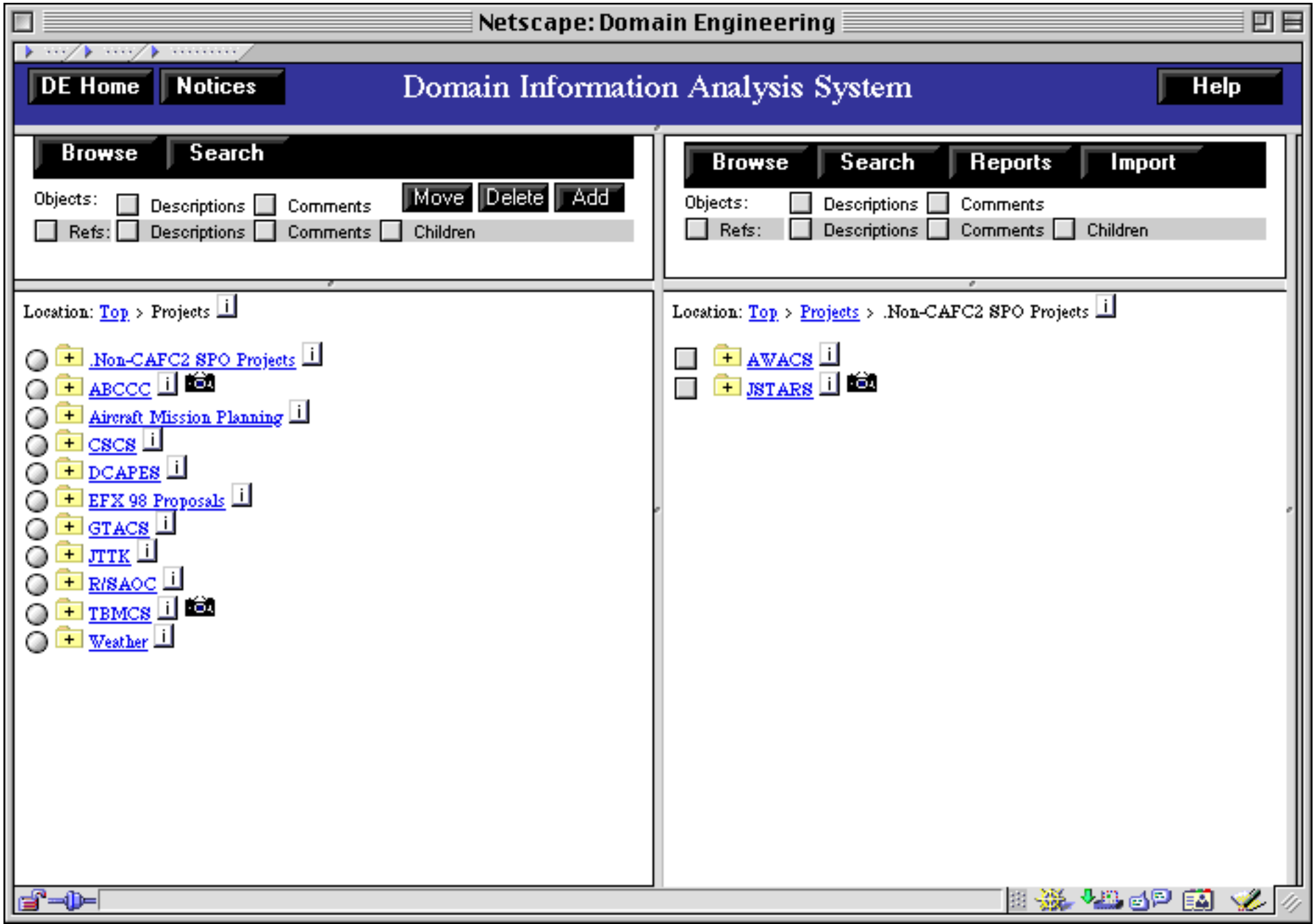
- We have collected the following information

Project	Functional Descriptions	Requirements		Segment Catalog	CSCI Descriptions
		Current	Future		
ABCCC	✓				
AWACS	✓				
CSCS	✓	✓			
DCAPES	✓	✓			
GTACS	✓				
JSTARS	✓				
JTTK	✓				
Mission Planning	✓				
R/SAOC	✓	✓			
TBMCS	✓	✓	✓	✓	✓
TMD	✓				
Weather	✓				

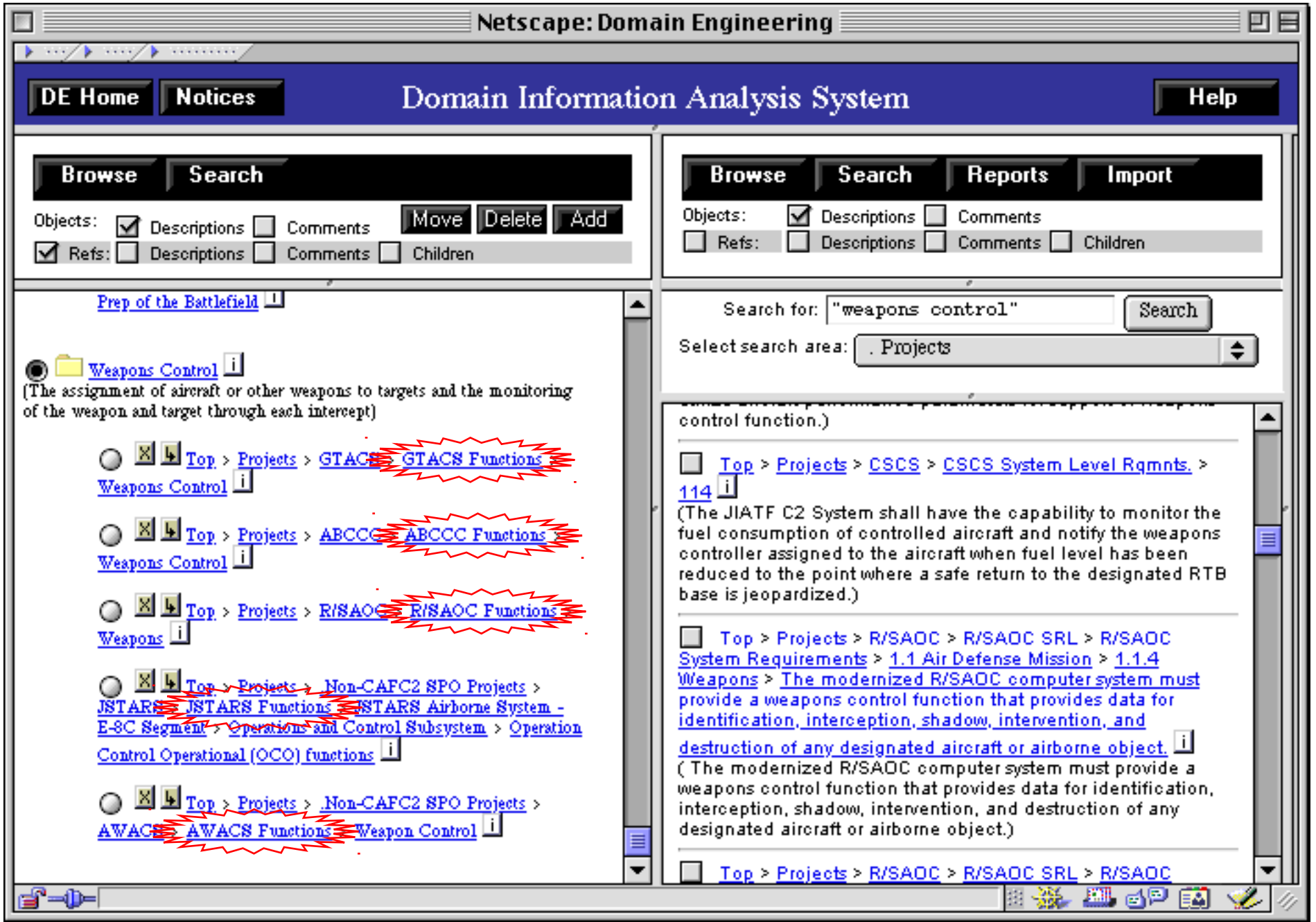
CAFC2 SPO Domain Information Analysis System - Demonstration

- Browse
- Create references
- Annotate objects and references
- Report generation

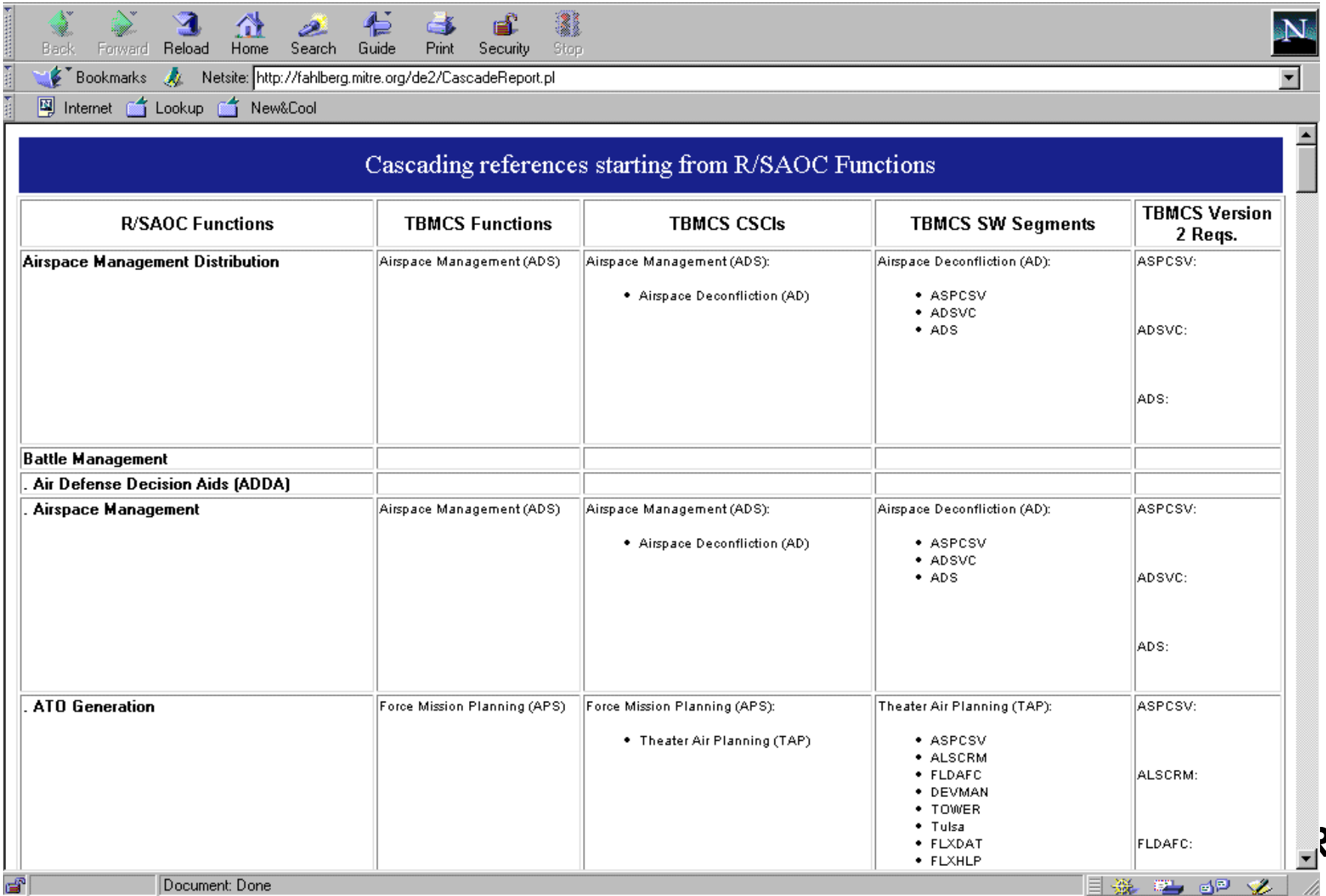
Domain Information Analysis System



Domain Information Analysis System



Report From DE Tool



Cascading references starting from R/SAOC Functions

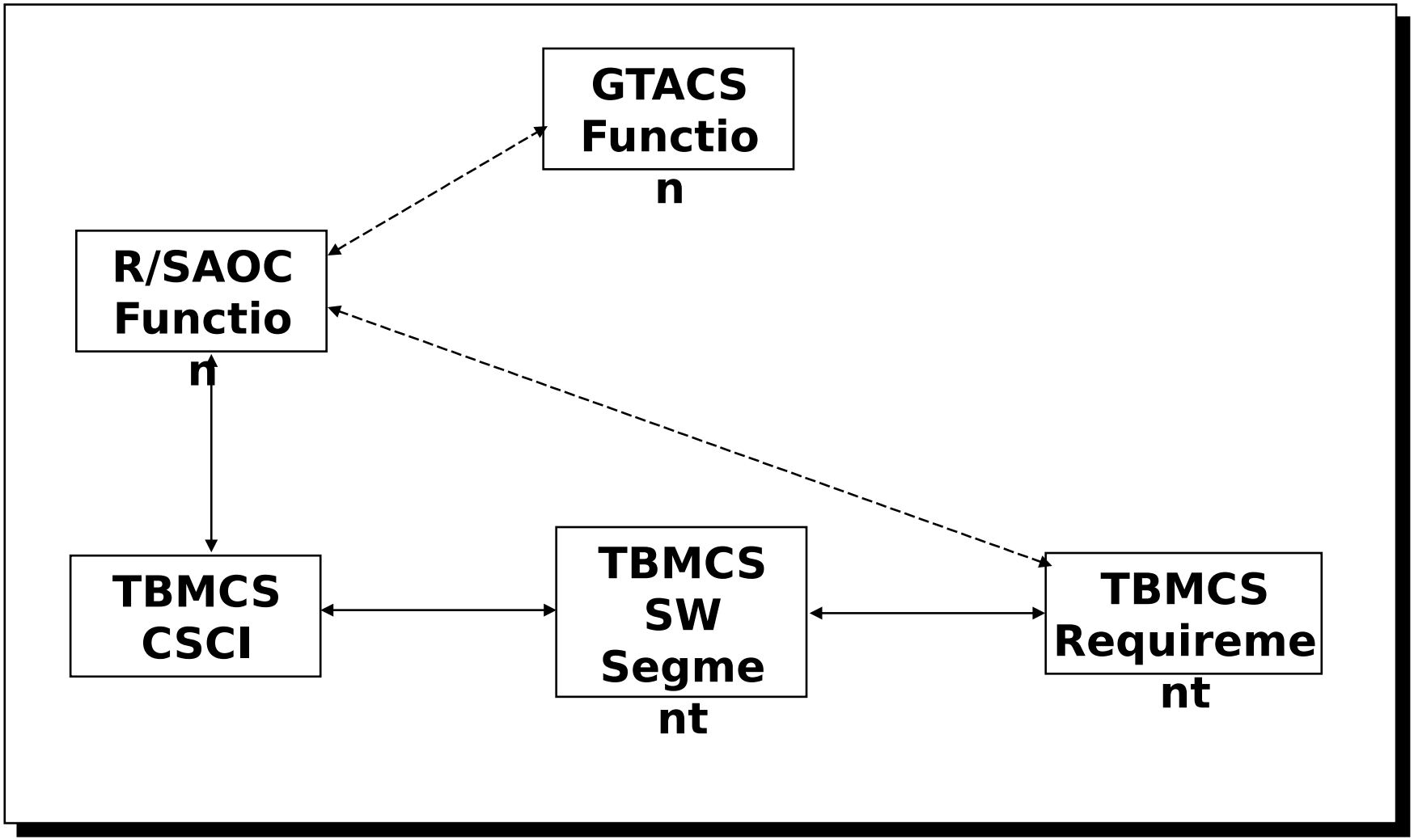
R/SAOC Functions	TBMCS Functions	TBMCS CSCIs	TBMCS SW Segments	TBMCS Version 2 Reqs.
Airspace Management Distribution	Airspace Management (ADS)	Airspace Management (ADS): • Airspace Deconfliction (AD)	Airspace Deconfliction (AD): • ASPCSV • ADSVC • ADS	ASPCSV: ADSVC: ADS:
Battle Management				
. Air Defense Decision Aids (ADDA)				
. Airspace Management	Airspace Management (ADS)	Airspace Management (ADS): • Airspace Deconfliction (AD)	Airspace Deconfliction (AD): • ASPCSV • ADSVC • ADS	ASPCSV: ADSVC: ADS:
. ATO Generation	Force Mission Planning (APS)	Force Mission Planning (APS): • Theater Air Planning (TAP)	Theater Air Planning (TAP): • ASPCSV • ALSCRM • FLDAFC • DEVMAN • TOWER • Tulsa • FLXDAT • FLXHLP	ASPCSV: ALSCRM: FLDAFC:

Combat Ops Example– Potential Common Functions

Level 1 Decomposition	Level 2 Decomposition
Surveillance	Radar Control Threat Identification Threat Tracking
Situation Awareness	Intelligence Information Threat Visualization Weather
Planning	Campaign Planning Airspace Management Threat Modeling Force Level Mission Planning Detailed Route/Objective Planning
Execution	Mission Monitoring Tactical Air Traffic Control Weapons Control
Core Services	MCGI Message Handling

Source: ESC/AC Domain Engineering Briefing

CAFC2 SPO Domain Information Analysis System - A Practical Example



Project Link Metrics

Projects	Number of links within Project	Number of links to other Projects	Number of links to Domains
ABCCC		2	16
AWACS		3	*
CSCS		32	124
DCAPES			3
GTACS		31	32
JSTARS			*
JTTK			29
Mission			29
R/SAOC	400	52	100
TBMCS	2304	50	676
Weather			3

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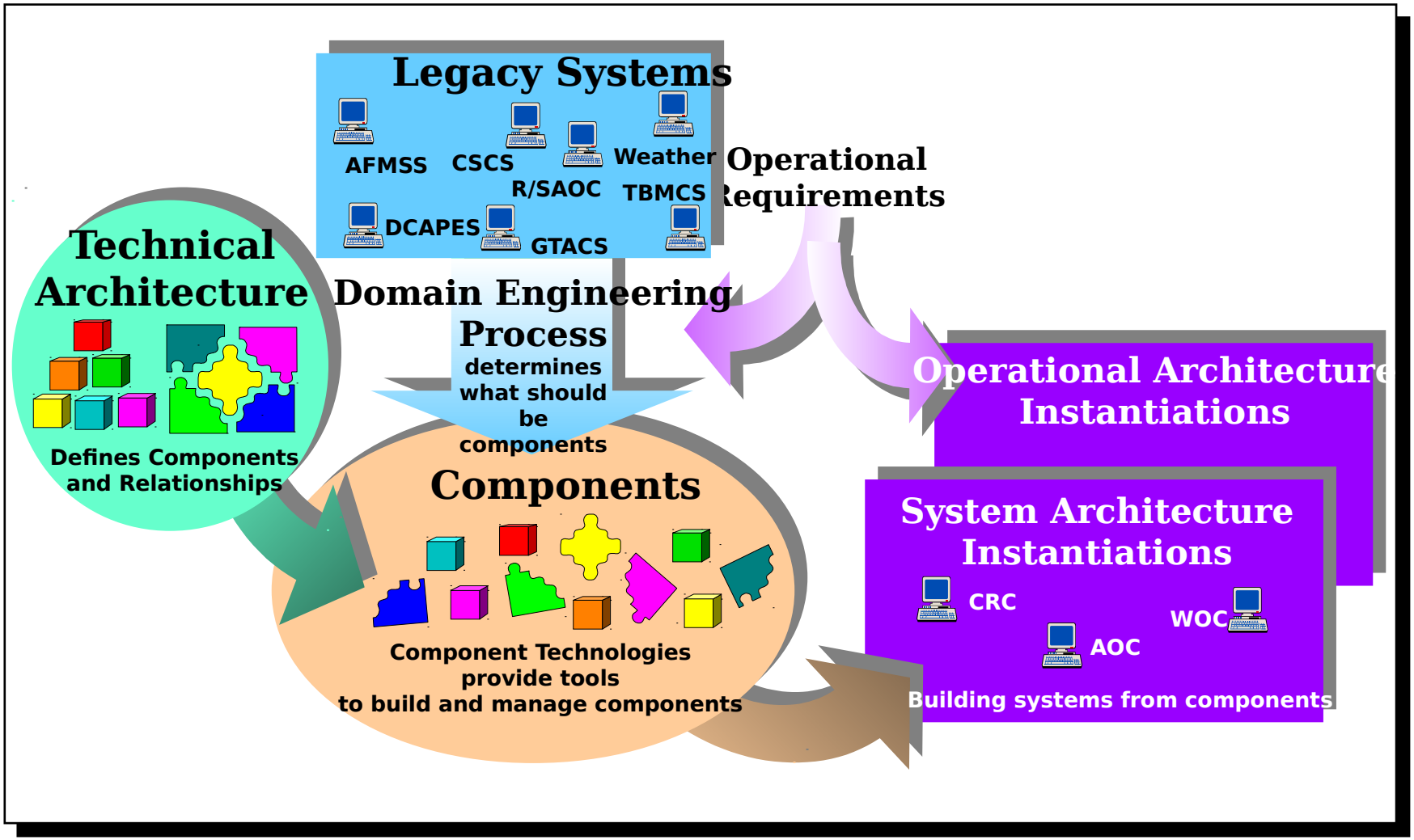
Architectures and Components



Component Technologies

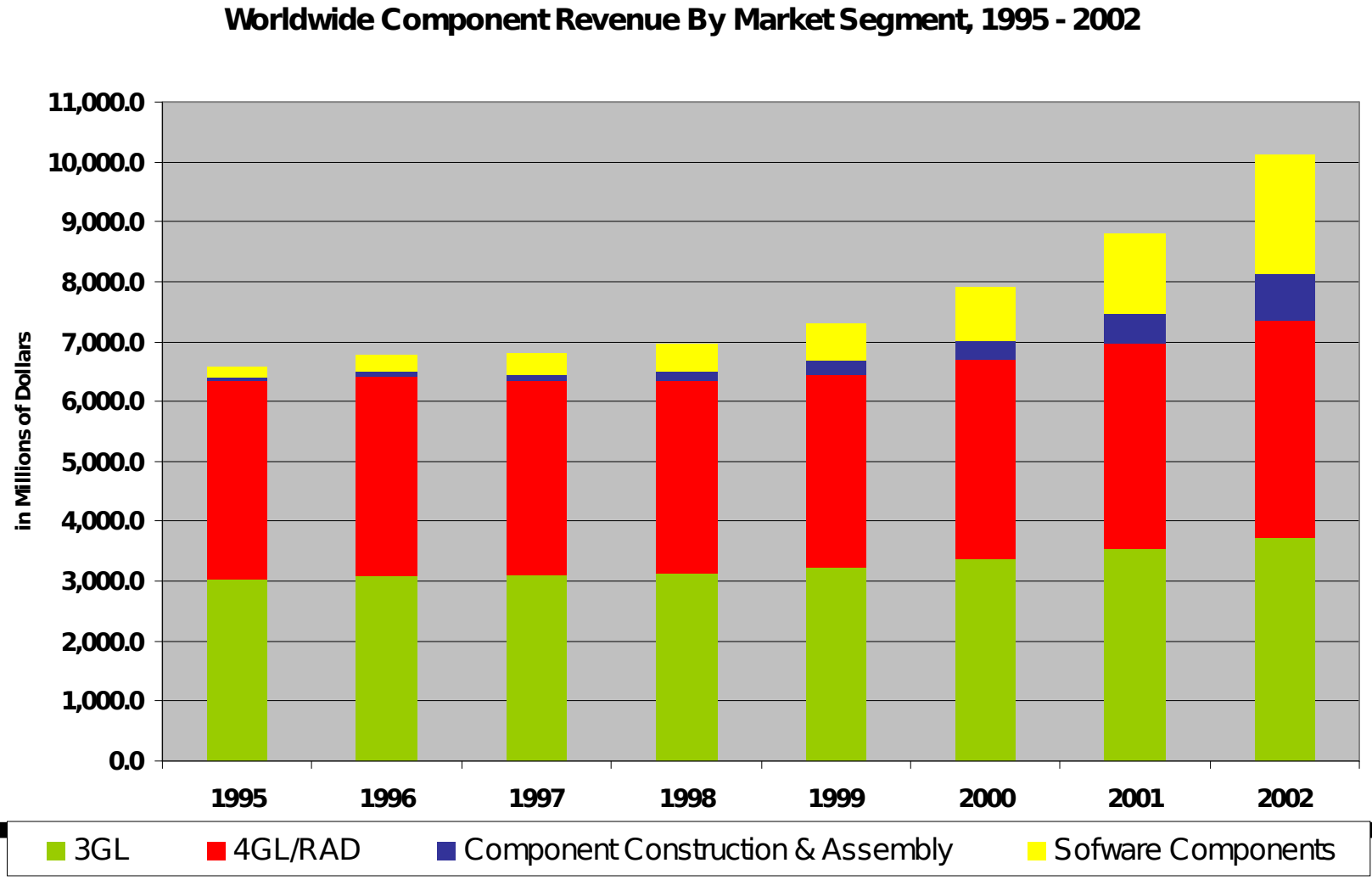
- **Component Characteristics**
  - **Defined Interface**
  - **Self-descriptive**
  - **Directly usable**
  - **Discrete**
  - **Reusable in different contexts**
  - **Quickly assembled into applicatio**
- **Technology Standards**
  - **JavaBeans**
  - **Enterprise JavaBeans (EJB)**
  - **CORBABeans**
  - **Microsoft COM/DCOM/COM+**

Component Definition:

"A software component is a unit of composition with contractually specified interfaces and explicit context dependencies only. A software component can be deployed independently and is subject to composition by third parties."*

* formulated at the 1996 European Conference on Object-Oriented Programming (ECOOP) from "Software Components" by Clemens Szyperski

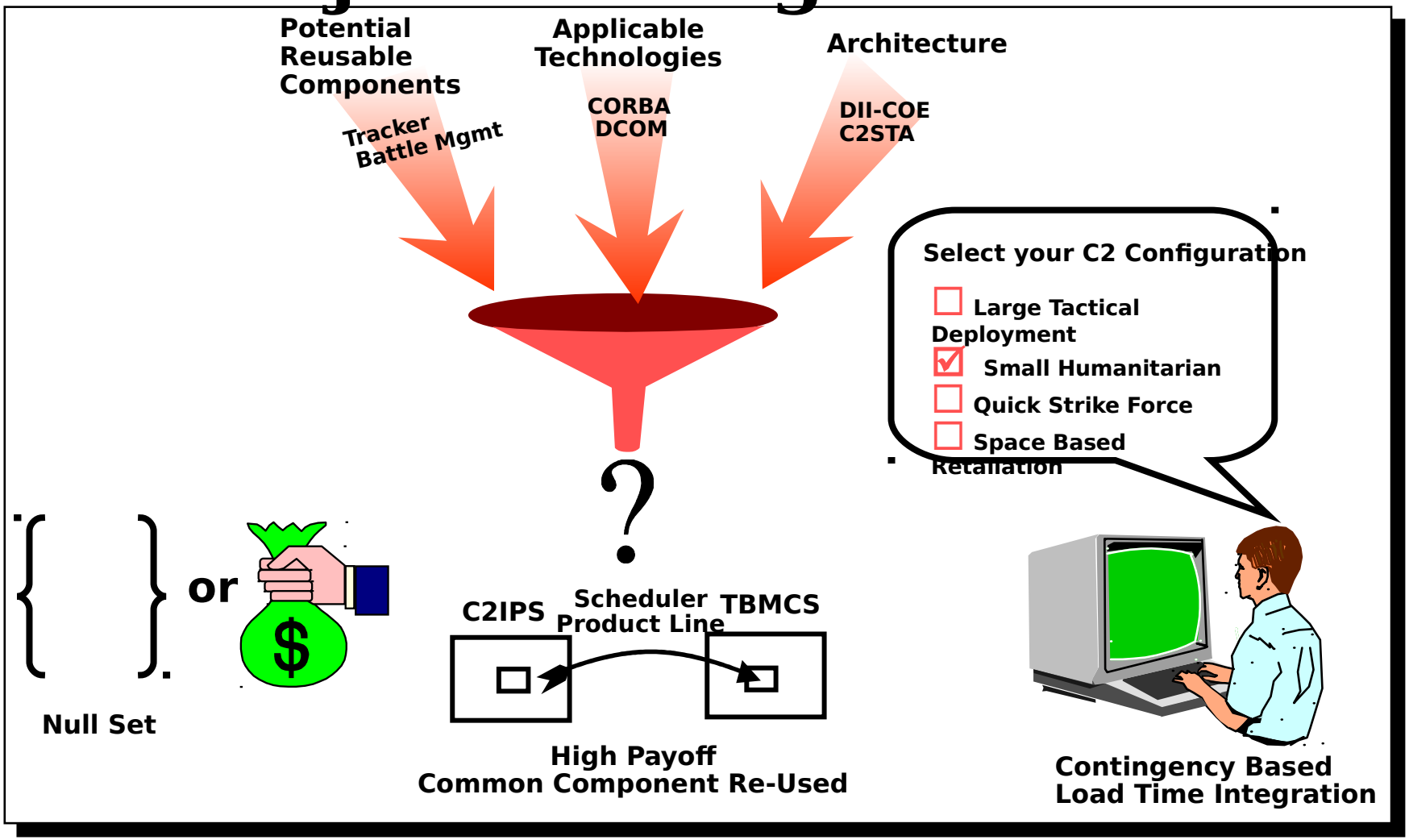
Commercial Directions: Component Technology



MITRE

Source: IDC, Garone, S., Hendrick, S., "Components Objects and Development Environments," May 1998.

Cautionary Note:
It's not just finding common comp



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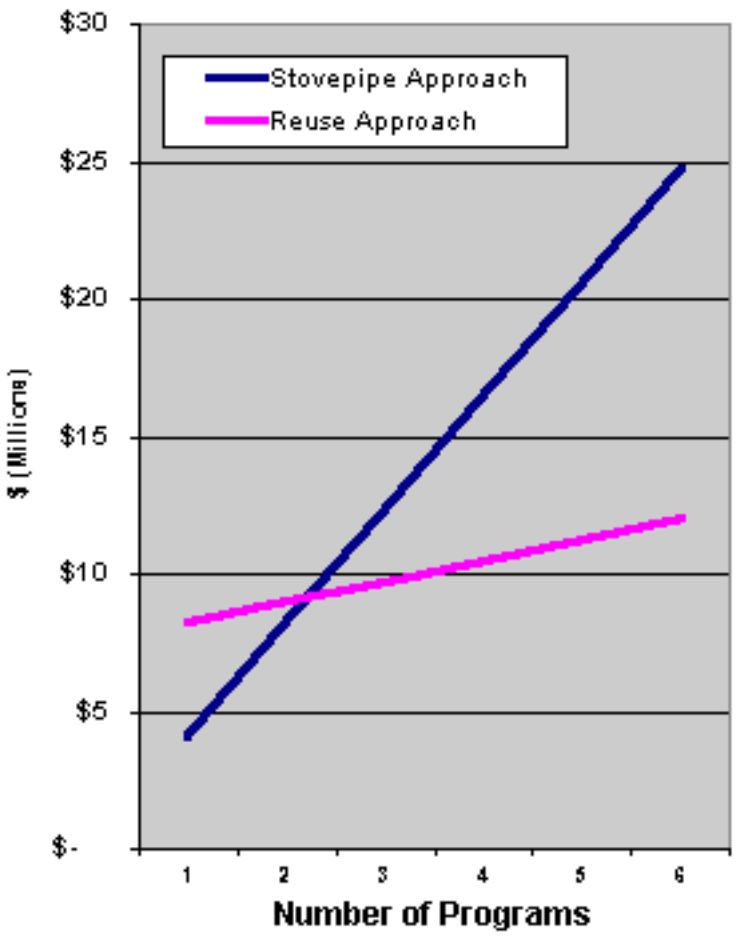
Business Strategies

- System Development needs to evolve from “build from scratch” mentality to “build by integrating existing components...when available”
  - Be advised: technology and available components still too immature to embrace fully
  - Is possible to pick and choose strategically now
- Business processes likely need significant revamp
  - address contractor incentivization
  - program manager incentivization
  - contracting vehicles and processes

The Payback of Software Re-use

- Parametric model of repeated development vs. develop for reuse
- Example: Compare 20,000 SLOC independent development vs. re-use of 30,000 SLOC (75% productivity)
  - Savings occur after the third re-use
- Break even not always the same, effected by:
  - Software size/complexity
  - Development productivity
  - Difficulty of integration
  - Need for/complexity of customization
- Total re-use savings across CAFSPO requires analysis of all opportunities
  - Sensitive to the amount of code needed to integrate
- Studies of commercial applications indicates re-use payback after third re-use [Toshiba]



Reducing Barriers to Software Re-Use

Contractor

Barrier	Potential Solution
Loss of Competitive Edge	- repository “advertises” product - award for domain “contractor of choice” - uniqueness fee
Loss of Revenue Flow	- license fees for each use - award fee as % of govt. savings - version upgrades - recognition that AF <> commercial volume
Performance Uncertainty	- incentives for performance enhancements - bonus to integration contractor

Reducing Barriers to Software Re-Use (Continued)

Government

Barrier	Potential Solution
Contracting processes lag composable system development approach	- "Big Stick" authority across multiple organizations - revamp/modify contracting processes - Is funding adequate to PADs?
Program Mgr. awarded for schedule/budget/ performance	- Award for schedule/budget/performance/ IC2S - "Why not re-use" as part of early acquisition strategy
Fewer CDRLs=we know less about products being developed	- mandate system essentials into info repository - payment based on currency/accuracy of data
Who maintains delivered components	- contractor maintenance - config management chief established
I want to save $ now!	- recognize $ savings is 2-3 years down the road - start small and evolve

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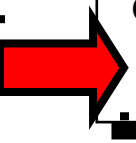


CAFSPO System Engineering Initiatives: A Model Roadmap?

1. Fully Populate CAF SPO Data Repository;
   - Help from SPOs, Contractors, CAO, DISA
   - Extend to broader C2?
2. Spearhead two significant SW Re-use initiatives
   - Large Scale: GTACS
   - Small Scale: Scheduler Product Line
   - Pilot efforts for future initiatives
3. Sponsor CAFSPO Architecture Day
4. Sponsor exchange with industry on topic "Component Engineering"

CAFSPO Database Population

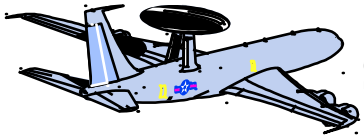
- **With support from SPOs, Contractors, CAO, DISA extend data that exists now**

Project	Functional Descriptions	Requirements Current	Requirements Future	Segment Catalog	CSCI Descriptions
ABCC	√	√	√	√	√
AWACS	√	√	√	√	√
CSCS	√	√	√	√	√
DCAPES	√	√	√	√	√
GTACS	√	√	√	√	√
JSTARS	√	√	√	√	√
JTTK	√	√	√	√	√
Mission Planning	√	√	√	√	√
R/SAOC	√	√	√	√	√
TBMCS	√	√	√	√	√
TMD	√	√	√	√	√
Weather	√	√	√	√	√

To include complete info from all programs

- **Database serves as CAFSPO information nucleus for all cross program initiatives**

Large Scale Component Re-Use: GTACS Modernization



R/SAOC
AWACS

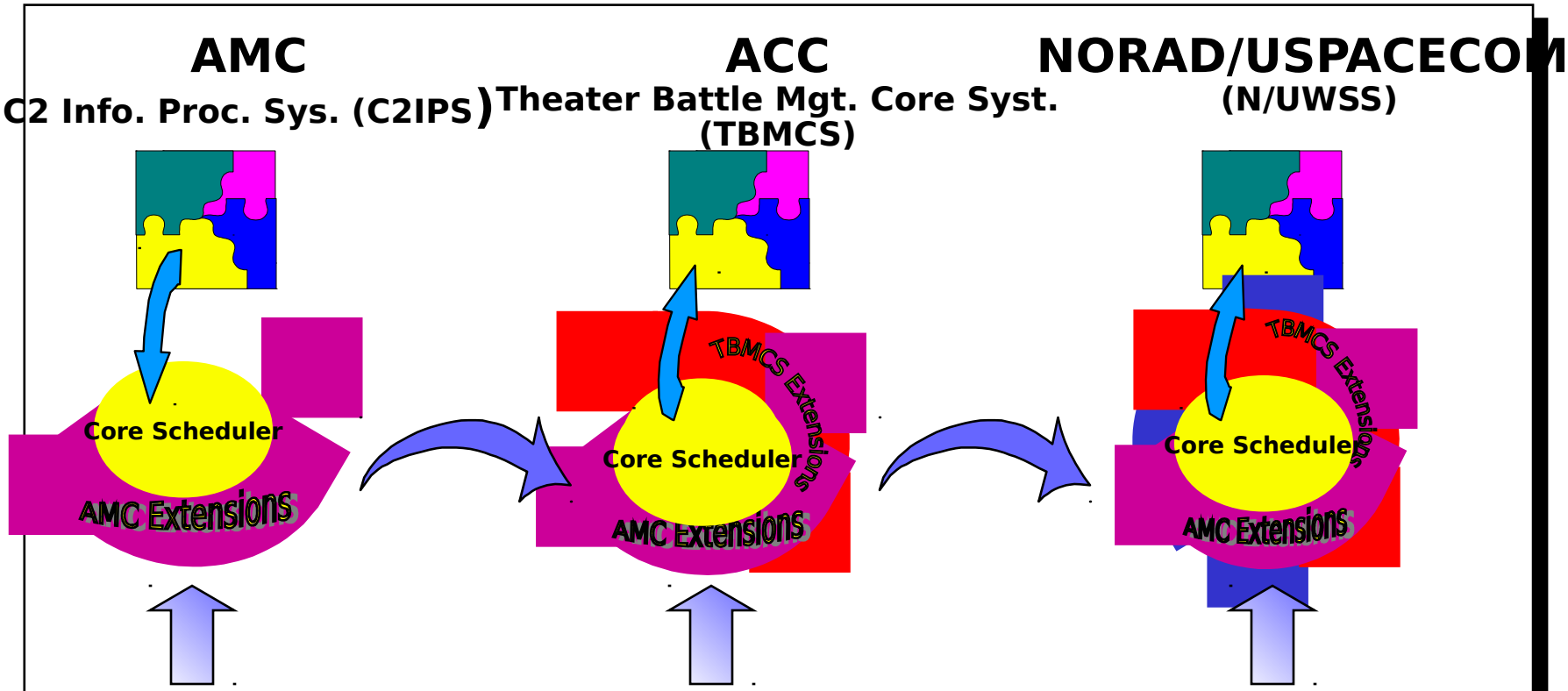
TBMCS

GTACS

System Engineering Role:

- Assess requirements similarities among programs
- Identify SW “Chunks” for re-use
- Evaluate architecture readiness to accept
- Suggest possible migration
- Suggest business approach

Smaller Scale Component Re-Use: Scheduler Product Line



CAFSPO Architecture Day

- **Forum to share architecture goals of CAFSPO with relevant contractors**
  - **Describe Integrated C2 System (IC2S) and role of CAFSPO programs**
  - **Describe guidance ESC is providing for development of architectures**
  - **Convey Operational Architecture and JV 2010 Vision**
  - **Solicit contractor suggestions and proposals toward achieving IC2S**
  - **Projected time frame: late spring**

Component Technology Conference

- Solicit CAFSPO contractors to share their corporate technology plans/initiatives
- Invite selected component vendors to discuss trends and share strategies, such as:
  - IBM
  - Computer Associates
  - Microsoft
  - Hewlett-Packard
  - SAS Institute
  - Oracle
  - Information Builders
  - Microfocus
  - Sun Microsystems
  - Fujitsu
- Share CAFSPO view on importance of component technology toward achieving IC2S
- Projected time frame: early summer 99

Summary

- System Engineering has created and developed a strong Domain Engineering infrastructure
  - Web based tool
  - Preliminary assessments across CAFC2 SPO
  - Domain experts
  - Begun integration with non-CAFSPO programs
- Completing four initiatives is essential to further progress
  - Fully populating information repository
    - Access to DISA DII COE DB essential also
  - Seizing GTACS Modernization opportunity
  - Partnering with Industry
    - Architecture Day
    - Component Technology Day